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Interim Report R & D Project 352

Database and Atlas of Aquatic  
Vascular Plants. Phase II.

C.D. Preston & J.M. Croft

April 1992

R & D 352/1/N



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## SUMMARY

The objectives of the Database and Atlas of Aquatic Vascular Plants project are to update or, where necessary, create computer files of records (with locality data) of 209 submerged, floating and emergent aquatic vascular plant taxa, and to summarise the known distribution of these taxa as maps. The project is planned in two stages. In Phase I (1989-1991) data were acquired on the 124 submerged and floating species (Preston, Croft & Forrest 1991). Work was also begun on capturing data from site-based datasets, i.e. those datasets which consist of lists of species at particular sites rather than lists of sites for particular species. This interim report covers the first year of Phase II (1991-1992), in which work on 36 site-based datasets has been completed. In the final year of the project (1992-1993), at least three further site-based datasets are expected in machine-readable form, data will be acquired on 85 emergent species and an Atlas of Aquatic Plants prepared for publication.

The 36 site-based datasets which have been incorporated into the database are described in this report. Most of these datasets were contained in unpublished reports, but some consisted of species lists on field survey sheets and other datasets were received in machine-readable form. Most of these datasets contained some records of terrestrial species, which have been computerised unless the time taken to include them would have significantly extended the period needed to process the data.

A total of 163 744 records from 10 745 sites has been incorporated into the database from the site-based surveys. The three largest datasets are the Nature Conservancy Council's England Field Unit survey of grazing marsh ditches (4 142 sites, 64 315 records), the NCC Chief Scientist's Directorate Scottish Loch survey (1 561 sites, 27 674 records) and NCC CSD records from miscellaneous standing waters (611 sites, 14 588 records). Other large datasets, each containing over 4 000 records from over 250 sites, are the Department of Agriculture (Northern Ireland)/Department of the Environment (Northern Ireland) survey of lakes in Northern Ireland, P.D. Goriup's survey of rivers and streams in the NCC South England region, surveys of miscellaneous sites by C.D. Preston and others, C.D. Preston & N.F. Stewart's survey of Donegal and R. Stokoe's records from Cumbrian lakes. The coverage of the site-based datasets is summarised as a series of maps.

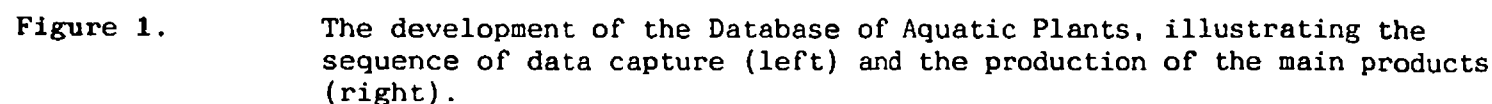
Sample draft accounts of species suitable for inclusion in an Atlas of Aquatic Plants are included for comment. The list of species covered by the project, which has been revised in the light of the *New Flora of the British Isles* (Stace 1991), is given in an Appendix.

The Database and Atlas of Aquatic Vascular Plants project is jointly funded by the Joint Nature Conservation Committee (JNCC), the National Rivers Authority (NRA) and the Natural Environment Research Council (NERC). The objectives of the project are:

- 1 to develop a database on the distribution of aquatic plants;
- 2 - - - - - to prepare summaries of the data for publication in an Atlas of Aquatic Plants.

The process of data capture is illustrated in Figure 1. The existing data on aquatic plants maintained by the Biological Records Centre (BRC) are being added to in two stages. In Phase I (1989-1991) data were acquired on the submerged and floating species. Work on capturing data from site-based datasets (i.e. datasets which consist of lists of species at particular sites rather than lists of sites for particular species) was begun. Interim distribution maps for submerged and floating species were plotted from the database and included in the report on Phase I (Preston, Croft & Forrest 1991). In Phase II (1991-1993) we will complete the capture of data from site-based datasets containing records of submerged, floating and emergent species (1991-1992), incorporate data on emergents from species-based datasets and prepare an Atlas of Aquatic Plants for publication (1992-1993). Species covered by the project are listed in Appendix A.

This interim report covers the first year of Phase II (1991-1992) and summarises the data acquired from site-based datasets during Phase I and Phase II. A final report on Phase II, to be submitted in March 1993, will contain distribution maps for all the taxa covered by the project accompanied by accounts of their ecology and reproductive biology. These will be prepared in a form suitable for publication in an Atlas of Aquatic Plants. Maps of environmental factors will also be included, and revised lists of nationally rare and scarce species and regionally notable species will be presented. Work on Phase II is covered by a contract between NERC and NRA which runs from October 1991 to March 1993, under which NRA provides approximately 45% of the total cost of Phase II. The remaining costs are split between JNCC and NERC, JNCC providing 28% and NERC 27% during the first year of Phase I.



Many site-based surveys of aquatic habitats contain data on submerged, floating and emergent species. These site-based datasets were therefore described as "mixed datasets" in earlier reports. Criteria for assessing the relative importance of datasets are outlined by Preston, Croft & Forrest (1991). The most significant site-based datasets were identified during Phase I and work on processing them begun. The completion of the work on these datasets has been the main activity during the first year of Phase II. The site-based datasets which have been computerised as part of the Database and Atlas of Aquatic Vascular Plants project are summarised in section 3.

In addition to records of aquatic plants as defined by our project, it soon became clear that many surveys of aquatic habitats include a small proportion of records of species which we do not regard as aquatics. These include waterside trees (eg *Alnus glutinosa*, *Salix* spp.), predominantly terrestrial species which are occasionally found in the water (eg *Agrostis stolonifera*, *Drosera rotundifolia*), species on the banks of water-bodies (eg *Carex panicea*, *Impatiens glandulifera*), colonists of the mud exposed by falling water levels (eg *Gnaphalium uliginosum*, *Polygonum hydropiper*), species in adjacent fens (eg *Epilobium palustre*, *Filipendula ulmaria*) and species of no affinity with moist habitats which nevertheless occasionally catch the fancy of the recorder (eg *Juniperus communis*, *Thalictrum minus*). We decided to include all the records of these species when processing the datasets, as they could be incorporated with very little extra effort. Incorporating these data keeps open the option of summarising the national distribution of these species at a later date or generating lists of species at a site without the need for an inefficient and prohibitively expensive reworking of the original data sources. Only in the case of one or two datasets which contain a high proportion of terrestrial species (eg Livermore & Livermore 1988) was it decided to restrict data input to the defined aquatic species. Records of species which are not covered by the Aquatic Plants project have not been included in the ORACLE table of Aquatic Plant records within the BRC database, but transferred to the appropriate table in the general database.

Many surveys of aquatic habitats include records of a few mosses and liverworts (particularly *Fontinalis antipyretica*) and a few also contain records of charophytes, based on expertly determined material. These records have also been input and transferred to the appropriate BRC table.

Datasets have been received in three forms, which have required different amounts of data processing.

- 1 Species lists for individual sites. These lists are either original field survey sheets or fair copies derived from such sheets. Processing these data has involved validation of locality data (see Preston, Croft & Forrest (1991) for details of data validation) and the addition of BRC species code numbers to the species recorded. These data were then input using normal BRC data-entry procedures.

- 2 Published papers or unpublished reports. These usually contain the condensed and summarised results of field surveys. A special sheet (illustrated in figures 2 and 3) was designed to assist in the extraction of data from such reports. The sheet listed the abbreviated names of species usually recorded in surveys of aquatic habitats, together with their BRC code numbers. The sheet was numbered RP20 in the sequence of BRC plant cards. Records from published papers or unpublished reports were usually transferred to such sheets, locality data were validated as the records were transferred and then records were input from RP20 sheets using standard BRC procedures.
- 3 Data received in machine-readable form. Some data received in machine-readable form contained all the essential fields included in the BRC database. These data required the least amount of processing: the species names or species code numbers usually had to be converted to the BRC code, and the data were then subjected to the standard BRC automatic data validation procedures. Other data received in machine-readable form contained locality codes but no locality names or lacked both locality names and grid references; these missing data may need to be input manually from the original record sheets.

All datasets were assessed for taxonomic reliability. Records which appear to be dubious or almost certainly erroneous have been retained in the database but tagged as doubtful; they will not appear on distribution maps or in summaries of national and regional status.

GRID REFERENCE										TETRAD	VICE COUNTY	DATE										RECORDER (S)	
																				NO:			
HABITAT										LOCALITY													
ALTITUDE																							

FERNS (0910)	382	hos	1038	Iris pse	1465	Phrag aus	1703	pal	2163	Veron ana
	386	las	1050	Juncu acuti	1480	Pingu lus	1704	syl	2166	bec
223 Azoll fil	388	lim	1054	art	1481	vul	1745	Rumex hyd	2167	cat
712 Equis arv	393	nigra	1058	*bul	1521	Polyg amp	1747	mar	2179	scu
713 flu	396	otr	1058.1	*bul(aqua)	1530	hyd	1749	pal	2164	ana x cat
717 pal	401	panicul	1058.2	*bul(terr)	1558	Potas alp	1759	Ruppi cir	2215	Viola pal
- Iscet agg	404	pen	1063	con	1559	ber	1758	mar	2231	Wolff arr
1043 ech	407	pse	1067	eff	1561	col			2237	Zanni pal
1045 lac	408	pul	1070	inf	1562	com	1767	Sagin pro		
1411 Osaun reg	413	rip	1076	sub	1563	crispus	1771	Sagit sag		
1474 Pilul glo	414	ros	1096	Lagar maj	1566	fil	1784	Salix alb		
	424	ves	1125	Lemna gib	1567	fri	1787	aur		
FLOWERING	387	vir bra	1126	minor	1568	gra	1788	cap	LIVERWORTS(0810)	
PLANTS (0920)	361	vir oed	2300	minus	1569	luc	1789	cin		
	419	vir vfr	1128	tri	1570	natans	1790	cin cin	909	Ricci flu
9 Achil pta	433	Catab aqu	1175	Litto uni	1572	nod	1786	cin ole	917	Ricci nat
15 Acoru cal	471	Cerat dem	1177	Lobel dor	1573	obt	1793	fra		
39 Agros sto	472	sub	1194	Lotus uli	1574	pec	1799	pen	MOSSSES (0820)	
62 Alism lan	510	Cicut vir	1198	Luron nat	1575	per	1801	pur		
63 pla	520	Cirsi pal	1210	Lychn flo	1576	polygon	1805	vim	222	Drepa adu
77 Alnus glu	523	Cladi mar	1219	Lycop eur	1577	pra	2350	x sep	276	Fonti ant
82 Alope gen	2423	Crass hel	1350	Lysim thy	1578	pus	1817	Samol val	281	squ
100 Anaga ten	629	Desch set	1225	vul	1581	tri	1851	Schoe lac	251	Rhync rip
109 Angel syl	654	Drosc ang	1444	Lythr por	2481	x coo	1852	tab	541	Scorp sco
135 Apium inu	655	int	1227	sal	2488	x lin	1855	Schoe nig	-	Sphag agg
137 nod	657	rot	1272	Menth aqu	1571	x nit	1860	Scirp mar	556	cus
224 Balde ran	2551	Egeri den	1289	Menya tri	2491	x oli	1861	syl		
234 Berul ere	671	Elati hex	1298	Mimul agg	1564	x sal	1872	Scute gal	OTHER SPECIES	
241 Biden cer	672	hyd	4329	cup x gut	2494	x spa	1891	Senec aqu		
242 tri	673	Eleoc aci	4328	gut s.s.	1580	x sue	1944	Sium lat		
288 Butom umb	674	sul	4331	gut x lut	1582	x ziz	1947	Solan dul		
292 Calam can	675	pal	4332	gut x var	1592	Poten pal	1955	Sonch pal		
293 epi	679	Eleog flu	1307	Molin cae	1625	Pulic dys	1980	Sparg ang		
2249 Calli agg	681	Elode can	1312	Monti fon	-	Ranun agg	1983	eme		
303.2 bru	997	nut	1319	Myoso lax	1643.1	aqu	1981	ere		
303 *ham	692	Epilo hir	1322	sco	1646	bau	1982	min		
303.1 ham	697	pal	1323	sec	1648	cir	1127	Spiro pol		
302 her	739	Erioc aqu	1326	Myoso aqu	1651	flamm	2003	Stach pal		
304 obt	740	Eriop ang	1328	Myric gal	1652	flu	2007	Stell als		
307.1 pla	743	lat	1330	Myrio alt	1653	hed	2015	pal		
307 *sta	744	vag	1331	spi	1655	lin	2017	Strat alo		
307.2 sta	763	Eupat can	1332	ver	1654	omi	2020	Subul aqu		
308 tru	833	Filip ulm	1334	Najas fle	1643.2	pel	2048	Thali fla		
310 Calth pal	882	Galiu *pal	1345	Narth oss	1643.8	pen pen	2102	Trigl pal		
328 Carda fle	887	uli	1356	Nupha lut	1643.9	pen pse	2110	Typha ang		
331 pra	932	Glyce dec	1357	pum	1643.6	pse pse	2111	lat		
340 Carex acuta	933	flu	1355	lut x pum	1643.7	pse ver	2880	ang x lat		
341 acuti	934	max	1358	Nymph alb	1663	ace	2126	Utric dio		
342 app	944	Groen den	1360	Nymph pel	1664	trich	2131	Utric aus		
343 aqu	966	Herac man	1362	Oenan aqu	1691	Rhync alb	2129	*int		
359 cur	981	Hippu vul	1363	cro	1701	Rorip amp	2130	min		
363 dia	995	Hotto pal	1364	fis	1346	mic	2132	*vul		
365 dio	998	Hydro mor	1365	flu	1348	*n-a	2133	vul		
367 disticha	999	Hydro vul	1437	Parna pal	1347	n-a	2139	Valer dio		
370 ech	1008	Hyper elo	1442	Pedic syl	1349	n-a x mic	2140	off		
371 ela	1026	Impat gla	1454	Phala aru						

\* denotes aggregate

Figure 2. The RP20 card devised for extracting records for the project from reports and field notes (side 1).

RARE, NOTABLE, CRITICAL AND OTHER TAXA Not included overleaf					
Species	6-Fig. Grid Ref.	Date	Habitat	Locality	Other Details (pop. size, determiner etc)

RP 20

Figure 3. The RP20 card (side 2).

The datasets already computerised during the project are listed below. In most cases these data have been checked and are now ready for loading into the ORACLE database management system.

Datasets are listed below in alphabetical order under the name(s) of the author(s) of papers or unpublished reports, the name(s) of field recorders or the names of recording teams. For each dataset the source of the records is cited, the coverage indicated briefly in terms of site(s), biological vice-counties and 10-km grid squares, and details given of the date of the survey, the main recorder(s), the unit of recording, the number of sites surveyed and the number of records incorporated into the database. A site is defined as a unique combination of grid reference and locality name. It should be noted that these details refer to data incorporated into the database, and will in some cases differ from the data given by the recorder(s) in their papers or reports. A site at which no species were recorded will, for example, be counted as a site visited during a field survey, but not included in the number of sites from which data have been incorporated into the database. In a few cases, details of which are given below, surveys of adjacent sites have been aggregated into 1-km square units before incorporation into the database.

The 36 datasets from which at least 50 species records have been obtained are listed below. The number of records received from site-based datasets is summarised in Table 1. An index of localities included in the site-based datasets is provided in section 3.37. For maps of the biological vice-counties and the 100-km squares of the national grids, see Figures 4 and 5 respectively.

Three datasets identified by Preston, Croft & Forrest (1991, section 3.5) have not yet been obtained. These are J.O. Mountford's survey of grazing marsh ditches, N.T.H. Holmes' river survey and the results of the watercourse surveys held by NRA Anglia region. We hope to obtain data from these three sources in machine-readable form during the final year of the project.

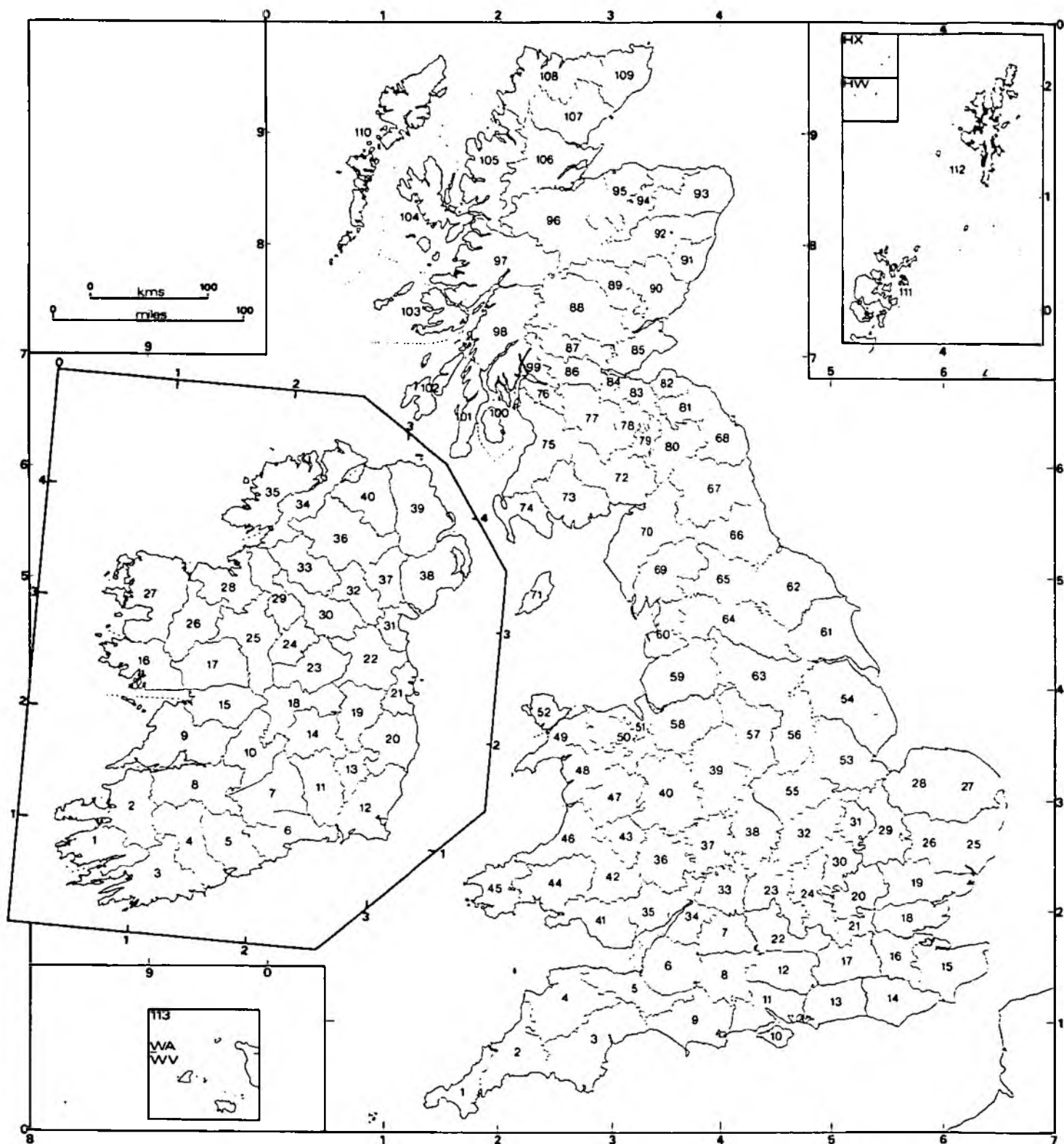


Figure 4.

Map of the biological vice-counties of Great Britain and Ireland. Irish vice-counties are prefixed by H (for Hibernia).

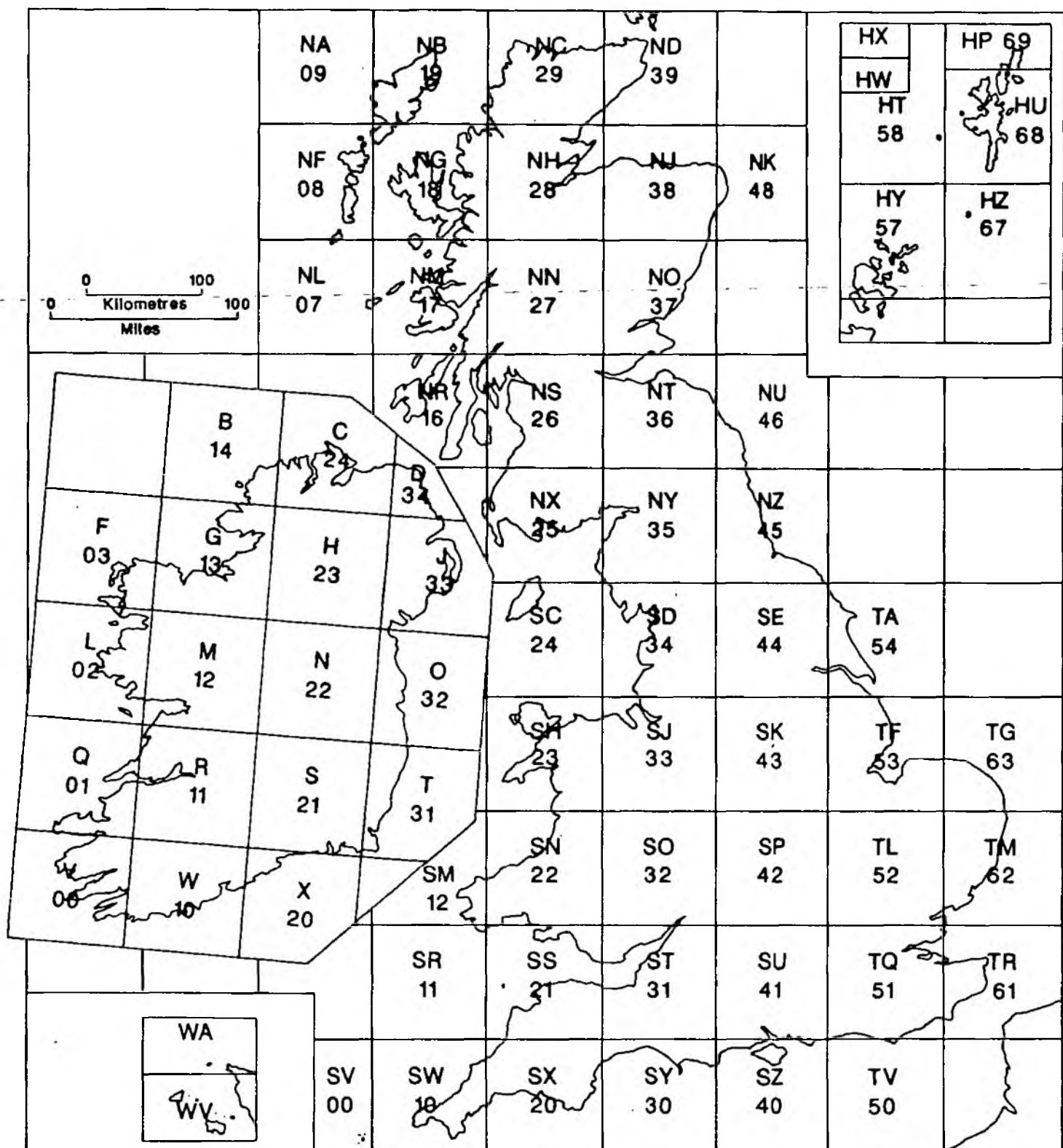


Figure 5.

Map of 100-km squares of the O.S. national grids, showing the numerical co-ordinates and their alphabetical equivalents.

**Table 1.** Summary of data captured from site-based data sets. Under format, P: published paper, R: unpublished report, F: field survey sheets, M: machine-readable form.

Dataset	Format	No. sites	No. records
3.1 Alder, Chesterfield Canal	R	39	696
3.2 Anderson & Murphy, Union Canal	R	61	756
3.3 Benfield & Margetts, Grand Western Canal	F	13	584
3.4 Biagi <i>et al.</i> , Lewis & Harris	R	27	622
3.5 Candlish, Grantham Canal	R	38	423
3.6 Chamberlain <i>et al.</i> , Outer Hebrides	R	24	845
3.7 CCW, Gwent Levels	F	129	2 148
3.8 DANI/DoE (NI) N. Ireland lakes	M	593	4 383
3.9 Driscoll, Broadland dykes	R	185	2 873
3.10 FitzGerald & Stewart, Ireland	F	142	1 423
3.11 Goriup, NCC S. Region	F	444	4 513
3.12 Hall, Basingstoke Canal	R	116	2 622
3.13 Henderson, Deal-Sandwich area	R	26	1 137
3.14 Heuff, Irish lakes	R	48	667
3.15 Hughes <i>et al.</i> , Gigha	F	6	120
3.16 Kendall, Leven Canal	R	8	87
3.17 Lambert <i>et al.</i> , Peterborough brickpits	R	5	39
3.18 Livermores, Lancaster Canal	R	71	2 185
3.19 NCC CSD GB standing waters	F	611	14 588
3.20 NCC CSD Scottish Loch survey	F	1 561	27 674
3.21 NCC EFU grazing marsh ditches	M	4 142	64 315
3.22 Preston, Jura	F	69	713
3.23 Preston <i>et al.</i> , British Isles	F	1 039	9 492
3.24 Preston & Stewart, Coll & Tiree	F	385	3 959
3.25 Preston & Stewart, Donegal	F	259	4 447
3.26 Preston & Stewart, Lismore	F	29	420
3.27 RBG Edinburgh, Outer Hebrides	R	19	701
3.28 Seddon, Welsh lakes	P	70	1 312
3.29 Stokoe, Cumbrian lakes	P	294	4 795
3.30 Tolhurst, Pocklington Canal	R	38	365
3.31 Ward, limestone pavement	F	48	64
3.32 Watson & Murphy, Forth & Clyde Canal	R	66	1 640
3.33 West, Scottish lakes	P	31	432
3.34 West, further Scottish lakes	P	82	1 367
3.35 Wigginton, Shropshire & Cheshire meres	R	19	257
3.36 Young & Stewart, Fife & Kinross	R	19	540
Total:		10 745	163 744

3.1      J. ALDER                      CHESTERFIELD CANAL

Source of records: Alder, J. (1986). A survey of the flora of the Chesterfield Canal. NCC contract survey no. 2. Unpublished report.

Coverage: Chesterfield Canal. Vice-county 56. Grid squares SK 68, 78, 79.

Recorder: J. Alder. Date: 1986.

Unit of recording: sections of canal bounded by bridges or locks.

Number of sites: 39 (excluding records from 11 locks not yet computerised). Number of records: 696.

3.2      K. ANDERSON & K.J. MURPHY                      UNION CANAL

Source of records: Anderson, K. & Murphy, K.J. (1987). The aquatic vegetation of the Union Canal (Lothian and Central Regions, Scotland). Unpublished report.

Coverage: Union Canal. Vice-counties 83, 84, 86. Grid squares NS 87, 97; NT 07, 17, 27.

Recorders: J. Sheldon *et. al.* (1976), K.J. Murphy (1977, 1980), K. Anderson & K.J. Murphy (1986). Date: 1976 (Lothian Region only), 1977 and 1980 (sample grid squares only), 1986.

Unit of recording: 1-km O.S. grid squares.

Number of sites: 61. Number of records: 756.

3.3      B. BENFIELD & L.J. MARGETTS                      GRAND WESTERN CANAL

Source of records: RP20 sheets compiled by L.J. Margetts.

Coverage: Grand Western Canal. Vice-counties 3, 4 (the canal forms the boundary between v.c. 3 and v.c. 4; records have been entered as v.c. 3). Grid squares SS 91; ST 01.

Recorders: B. Benfield & L.J. Margetts. Date: 1984-1985.

Unit of recording: sections of canal bounded by bridges.

Number of sites: 13. Number of records: 584.

3.4      J.A. BIAGI ET AL.                      LOCHS IN LEWIS AND HARRIS

Source of records: Biagi, J.A., Chamberlain, D.F., Hollands, R.C., King, R.A. & McKean, D.R. (1985). Freshwater macrophyte survey of selected lochs in Lewis and Harris. Unpublished report.

**Coverage:** selected coastal lochs in Lewis and Harris, Outer Hebrides. Vice-county 110. Grid squares NG 08; NB 01, 03, 13, 23, 24, 32, 34, 35, 43, 46, 54, 56.

**Recorders:** survey team from Royal Botanic Garden, Edinburgh.  
**Date:** 1985.

**Unit of recording:** individual lochs.

**Number of sites:** 27. **Number of records:** 622.

3.5      P.A. CANDLISH                      GRANTHAM CANAL

**Source of records:** Candlish, P.A. (1975). Grantham Canal survey. Unpublished report.

**Coverage:** Grantham Canal. Vice-counties 53, 55, 56. Grid squares SK 63, 72, 73, 83, 93.

**Recorder:** P.A. Candlish. **Date:** 1975.

**Unit of recording:** sections of canal bounded by bridges or locks.

**Number of sites:** 38. **Number of records:** 423.

3.6      D.F. CHAMBERLAIN ET AL.                      LOCHS IN OUTER HEBRIDES

**Source of records:** Chamberlain, D.F., King, R.A., McKean, D.R., Miller, A.G. & Nyberg, J.A. (1984). Freshwater macrophyte survey of selected lochs in the Uists. Unpublished report.

**Coverage:** selected lochs in S. Uist, Benbecula, N. Uist and Berneray. Vice-county 110. Grid squares NF 72, 73, 75, 76, 77, 98.

**Recorders:** survey team from Royal Botanic Garden, Edinburgh.  
**Date:** 1984.

**Unit of recording:** individual lochs.

**Number of sites:** 24. **Number of records:** 845 (this excludes records of *Callitriche hermaphrodita*, *Nymphaea alba* and *Potamogeton* spp., processed earlier).

3.7      COUNTRYSIDE COUNCIL FOR WALES.                      GWENT LEVELS.

**Source of records:** copies of species lists provided by Miss J. Barneveld (CCW).

**Coverage:** ditches in Gwent Levels. Vice-county 35. Grid squares ST 27, 28, 38, 48.

Recorders: Contract survey team. Date: 1991.

Unit of recording: sample 20m ditch lengths.

Number of sites: 129. Number of records: 2 148.

3.8 DEPARTMENT OF AGRICULTURE (NORTHERN IRELAND)/DEPARTMENT OF THE ENVIRONMENT (NORTHERN IRELAND) N. IRELAND LAKES

Source of records: machine-readable form.

Coverage: lakes in Northern Ireland (Antrim, Armagh, Down, Fermanagh, Londonderry, Tyrone). Vice-counties H 33, 36-40. Grid squares - see Figure 6.

Recorders: survey team based at DANI and funded by DoE(NI).  
Date: 1988-1990.

Unit of recording: individual lakes

Number of sites: 593                      Number of records: 4 383

Note: the above details refer to records of submerged and floating species made during the first 3 years of the survey. Data of submerged and floating species made in the last 2 years of the survey and records of emergent species are expected in 1992.

3.9 R.J. DRISCOLL DYKES IN BROADLAND

Source of records: Driscoll, R.J. (1975). Distribution maps of aquatic macrophytes and bryophytes recorded in drainage dykes in Broadland, 1972-1974. Unpublished report.

Coverage: ditches in Broadland. Vice-county 27. Grid squares TM 49; TG 30-32, 40-42, 50, 51.

Recorders: R.J. Driscoll, assisted by D.J. Harcombe and A.J. Lees. Date: 1972-1974.

Unit of recording: maps show distribution in 0.5 x 0.5 km O.S. grid squares, which were aggregated into 1-km squares for data processing.

Number of sites: 185 1-km squares. Number of records: 2 873 (excluding records of *Groenlandia densa*, *Nuphar lutea*, *Nymphaea alba*, *Potamogeton* spp. and *Zannichellia palustris*, processed earlier, and records of bryophytes and some terrestrial species, which have not been processed).

- 3.10 LADY R. FITZGERALD & N.F. STEWART IRISH SITES  
**Source of records:** RP20 sheets compiled by the recorders.  
**Coverage:** miscellaneous sites in Ireland. Vice-counties H 9, 10, 12-16, 18-23, 28, 32, 33, 40. Grid squares - see Figure 7.  
**Recorders:** Lady R. FitzGerald, N.F. Stewart *et al.* **Date:** 1991.  
**Unit of recording:** individual sites.  
**Number of sites:** 142. **Number of records:** 1 423.
- 3.11 P.D. GORIUP RIVERS AND STREAMS IN S. ENGLAND  
**Source of records:** Copies of NCC South Region Macrophyte Recording cards held by BRC, and printout of site records borrowed from CSD, NCC, Peterborough.  
**Coverage:** rivers and streams in NCC South Region. Vice-counties 6-8, 10-13, 17, 22-24, 30, 32, 33. Grid squares - see Figure 7.  
**Recorder:** P.D. Goriup. **Date:** 1977-1978.  
**Unit of recording:** sample 30m (1977) or 50m (1978) lengths of streams and rivers.  
**Number of sites:** 444. **Number of records:** 4 513.
- 3.12 C. HALL BASINGSTOKE CANAL  
**Source of records:** Hall, C. (1988). *Survey of the flora of the Basingstoke Canal 1986-87*. Nature Conservancy Council, Peterborough.  
**Coverage:** Basingstoke Canal, offside flashes and adjacent sites with wetland species. Vice-counties 12, 17. Grid squares SU 65, 75, 85, 95; TQ 05, 06.  
**Recorder:** C. Hall. **Date:** 1986-1987.  
**Unit of recording:** sections of canal bounded by bridges or locks; site lists provided for adjacent habitats.  
**Number of sites:** 116. **Number of records:** 2 622.
- 3.13 A.C.B. HENDERSON DYKES IN DEAL-SANDWICH AREA  
**Source of records:** Henderson, A.C.B. (1982). Biological survey of the pastures and dykes of the Sandwich-Deal area, 1982. Unpublished report.

Coverage: ditches in Deal-Sandwich area. Vice-county 15. Grid square TR 35.

Recorder: A.C.B. Henderson. Date: 1982.

Unit of recording: individual ditches; records were aggregated into 1-km O.S. grid squares for data-processing.

Number of sites: 26 1-km squares. Number of records: 1 137.

3.14 H. HEUFF IRISH LAKES

Source of records: Heuff, H. (1984). The vegetation of Irish lakes. Unpublished report, extracted onto RP20 sheets by N.F. Stewart.

Coverage: selected Irish lakes. Vice-counties H 1, 6, 8, 9, 12, 14, 16, 17, 20, 23-26, 28-30, 35. Grid squares - see Figure 8.

Recorders: H. Heuff & J. Ryan. Date: 1977-1984 (mainly 1977-1978).

Unit of recording: individual lakes (some larger sites subdivided).

Number of sites: 48. Number of records: 667.

3.15 M.G.B. HUGHES, C.D. PRESTON & N.F. STEWART GIGHA

Source of records: field records transferred to RP20 sheets.

Coverage: lakes and other aquatic habitats on the island of Gigha. Vice-county 101. Grid squares NR 64, 65.

Recorders: M.G.B. Hughes, C.D. Preston & N.F. Stewart. Date: 1991.

Unit of recording: individual lakes and other sites.

Number of sites: 6. Number of records: 120.

3.16 S. KENDALL LEVEN CANAL

Source of records: Kendall, S. (1987). Botanical survey of the Leven Canal (with notes on hydrology). Unpublished report.

Coverage: Leven Canal. Vice-county 61. Grid squares TA 04, 14.

Recorder: S. Kendall

Unit of recording: 500m lengths of canal; all submerged species included on maps with target notes on some emergents. Records

were converted for data-processing into lists for 1-km O.S. grid squares.

Number of sites: 8 1-km squares. Number of records: 87.

3.17      S.J.J. LAMBERT ET AL.                      PETERBOROUGH BRICKPITS

Source of records: Lambert, S.J.J., Smyth, W.H. & Palmer, M.A. Peterborough Southern Brickpits. Report on pits surveyed in 1989 by the Nature Conservancy Council. Unpublished report.

Coverage: brickpits S. of Peterborough. Vice-county 31. Grid square TL 19.

Recorders: S.J.J. Lambert, M.A. Palmer & W.H. Smyth.

Unit of recording: individual brickpits.

Number of sites: 5. Number of records: 39.

Note: the copy of the report available to BRC proved to be incomplete. Further records will be added once a complete copy has been located.

3.18      L.A. & P.D. LIVERMORE                      LANCASTER CANAL

Source of records: Livermore, L.A. & Livermore, P.D. [1988]. The flowering plants, ferns and rusts of the Lancaster Canal in the Lancaster District. Unpublished report.

Coverage: Lancaster Canal, Lancaster district. Vice-county 60. Grid squares SD 45, 46, 47, 57.

Recorders: L.A. & P.D. Livermore.

Unit of recording: sections of canal bounded by bridges.

Number of sites: 71. Number of records: 2 185 (excludes records of some terrestrial species, which were not computerised).

3.19      NATURE CONSERVANCY COUNCIL CHIEF SCIENTIST'S TEAM/DIRECTORATE  
MISCELLANEOUS SITES IN GREAT BRITAIN

Source of records: copies of Standing and Flowing Water Habitats cards held (when copied) by NCC CSD, Peterborough.

Coverage: miscellaneous standing waters (including canals) in Great Britain. Vice-counties 2-6, 9, 12-15, 17, 20, 22-24, 27-32, 35, 37-42, 46, 48, 49, 52-56, 58-61, 63-65, 67, 69, 70, 72-75, 77-81, 84-92, 96, 98, 102, 104-106, 108-112. Grid squares - see Figure 8.

Recorders: chiefly C. Newbold and M.A. Palmer, with additional records (made by employees of NCC) acquired by them.

Unit of recording: individual sites.

Number of sites: 611. Number of records: 14 588.

Note: this dataset includes records from lakes in Cumbria (E. Charter, 1983), ponds in West Midlands (J.J. Day, 1979-1980), the Shropshire and Cheshire Meres (NCC England Field Unit, 1979) and aquatic habitats in Lincolnshire (H. Drewitt & T. Smith, 1986).

3.20 NATURE CONSERVANCY COUNCIL CHIEF SCIENTIST'S DIRECTORATE  
SCOTTISH LOCH SURVEY

Source of records: copies of site lists.

Coverage: selected lochs in Caithness & Sutherland, Deeside, Inverness, Moray & Nairn, Orkney, Skye & Lochalsh, S. Argyll, Spey Valley and Wester Ross. Vice-counties 91, 92, 94-98, 101, 104-109, 111. Grid squares - see Figure 6.

Recorders: NCC CSD survey team. Date: 1984-1990.

Unit of recording: individual lochs.

Number of sites: 1 561      Number of records: 27 674.

Note: these records were computerised from copies of site lists provided by the survey team, and returned to the team in machine-readable form.

3.21 NATURE CONSERVANCY COUNCIL ENGLAND FIELD UNIT      GRAZING  
MARSH DITCHES

Source of records: transferred from the English Nature Prime computer in machine-readable form.

Coverage: grazing marsh ditches in Broadland, Derwent Ings, Essex coast, Exminster Marshes, North Norfolk coast and Suffolk coast. Vice-counties 3, 18, 19, 25, 27, 28, 61. Grid squares - see Figure 9.

Recorders: NCC EFU survey teams. Date: 1987-1989.

Unit of recording: sample lengths of ditch, surveyed using the methodology described by Alcock & Palmer (1985).

Number of sites: 4 145. Number of records: 64 315.

Note: These records are the results of EFU projects 47, 49, 76, 77 and 78 (Palmer 1991). Grid references are not on file for the sample sites in the Exminster Marshes and Derwent Ings. Records from the two earliest EFU grazing marsh ditch surveys (North Kent

Marshes and Pevensey Levels) are not available in machine-readable form.

3.22      C.D. PRESTON                      JURA

Source of records: field records transferred to RP20 sheets.

Coverage: selected aquatic habitats on Jura. Vice-county 102. Grid squares NR 47, 57, 58, 68, 69.

Recorders: C.D. Preston and other botanists on BSBI Jura field meeting. Date: 1991.

Unit of recording: individual sites.

Number of sites: 69. Number of records: 713

3.23      C.D. PRESTON ET AL.                      SITES IN BRITISH ISLES

Source of records: C.D. Preston's aquatic notebooks I-VIII, transferred to RP20 sheets.

Coverage: miscellaneous sites for aquatic plants in the British Isles. Vice-counties 1-5, 7, 9, 11, 17, 22, 23, 25, 27-29, 31-34, 36, 37, 40, 49, 50, 52-56, 59, 60, 63, 64, 68, 70, 73, 74, 77, 80, 81, 83, 86-89, 92, 96, 98, 99, 101, 102, 104-106, 110, H9, 14-17, 19, 21, 23, 25-29, 33, 38-40. Grid squares - see Figure 10.

Recorders: C.D. Preston, often with N.F. Stewart, J.M. Croft or others. Date: 1986-1991.

Unit of recording: individual sites.

Number of sites: 1 039. Number of records: 9 492 (excludes some records of *Potamogeton* spp. processed earlier).

Note: Intensive surveys of particular areas are treated separately - see 3.15, 3.22, 3.24, 3.25 and 3.26.

3.24      C.D. PRESTON & N.F. STEWART                      COLL AND TIREE

Source of records: C.D. Preston's aquatic notebooks V, VII and VIII, transferred to RP20 sheets.

Coverage: lochs and other aquatic habitats on Coll and Tiree. Vice-county 103. Grid squares NL93, 94; NM 04, 05, 15, 16, 25, 26.

Recorders: C.D. Preston & N.F. Stewart. Date: 1989-1990.

Unit of recording: individual sites.

Number of sites: 385. Number of records: 3 959.

- 3.25      C.D. PRESTON & N.F. STEWART              DONEGAL
- Source of records: C.D. Preston's aquatic notebooks VI and VII and C.D. Preston and N.F. Stewart's field records, all transferred to RP20 sheets.
- Coverage: aquatic habitats in Donegal. Vice-counties H34, 35. Grid squares - see Figure 9.
- Recorders: C.D. Preston & N.F. Stewart. Date: 1989-1991.
- Unit of recording: individual sites.
- Number of sites: 259. Number of records: 4 447.
- 
- 3.26      C.D. PRESTON & N.F. STEWART              LISMORE
- Source of records: C.D. Preston's aquatic notebook VIII, transferred to RP20 sheets.
- Coverage: aquatic habitats on Lismore. Vice-county 98. Grid squares NM 73, 83, 84.
- Recorders: C.D. Preston & N.F. Stewart. Date: 1990.
- Unit of recording: individual sites.
- Number of sites: 29. Number of records: 420.
- 
- 3.27      ROYAL BOTANIC GARDEN, EDINBURGH              S. UIST & BENBECULA
- Source of records: Royal Botanic Garden, Edinburgh [1983]. Survey of aquatic vegetation on South Uist and Benbecula 25 July - 5 August 1983. Unpublished report.
- Coverage: selected eutrophic lochs in S. Uist and Benbecula. Vice-county 110. Grid squares NF 71-75.
- Recorders: survey team from Royal Botanic Garden, Edinburgh. Date: 1983.
- Unit of recording: individual lochs.
- Number of sites: 19. Number of records: 701 (this excludes records of *Nymphaea alba* and *Potamogeton* spp., processed earlier).

- 3.28      B. SEDDON                      WELSH LAKES
- Source of records: Seddon, B. (1972). Aquatic plants as limnological indicators. *Freshwater Biology* 2, 107-130.
- Coverage: selected lakes in Wales. Vice-counties 41-52. Grid squares - see Figure 6.
- Recorders: B. Seddon and over 30 other recorders co-ordinated by him. Date: 1961-1966.
- Unit of recording: individual lakes.
- Number of sites: 70. Number of records: 1 312.
- 
- 3.29      R. STOKOE                      CUMBRIAN LAKES
- Source of records: Stokoe, R. (1983). *Aquatic macrophytes in the tarns and lakes of Cumbria*. Occasional Publication no. 18. Freshwater Biological Association.
- Coverage: lakes, reservoirs and ponds in Cumbria. Vice-counties 69, 70. Grid squares - see Figure 6.
- Recorder: R. Stokoe. Date: 1975-1980.
- Unit of recording: individual sites.
- Number of sites: 294. Number of records: 4 795.
- 
- 3.30      S.A. TOLHURST                      POCKLINGTON CANAL
- Source of records: Tolhurst, S.A. (1987). A survey of the aquatic flora of the Pocklington Canal, Yorkshire. 1986. Edited by H.E. Stace & M.A. Palmer. Unpublished report.
- Coverage: Pocklington Canal. Vice-county 61. Grid square SE 74.
- Recorder: S.A. Tolhurst. Date: 1986.
- Unit of recording: sample 20m lengths of canal.
- Number of sites: 38. Number of records: 365.
- 
- 3.31      S. WARD                      LIMESTONE PAVEMENT
- Source of records: field cards compiled by S. Ward and held at BRC.
- Coverage: limestone pavement in Great Britain. Vice-counties 42, 60, 64, 69. Grid squares SN 91; SD 47, 48, 57, 58, 67, 77, 86, 87, 96; NY 60, 61, 70.

Recorder: S. Ward. Date: 1972-1974.

Unit of recording: individual sites.

Number of sites: 48. Number of records: 64.

Note: this dataset was not computerised as part of the Aquatic Plants project, but rather unexpectedly provided records of 6 aquatic plant species. Most of these records were of *Juncus articulatus* (39 records) and *Phalaris arundinacea* (20). The data on coverage and number of records refer solely to the records of aquatic plants, not to the entire dataset.

3.32      K.J. WATSON & K.J. MURPHY      FORTH & CLYDE CANAL

Source of records: Watson, K.J. & Murphy, K.J. (1988). The aquatic vegetation of the Forth and Clyde Canal 1988. Unpublished report.

Coverage: Forth and Clyde Canal. Vice-counties 76, 77, 86, 99. Grid squares NS 47, 56, 57, 67, 77, 87, 88, 98.

Recorders: K.J. Watson & K.J. Murphy. Date: 1988.

Unit of recording: 1-km O.S. grid squares.

Number of sites: 66. Number of records: 1 640.

3.33      G.T. WEST      SCOTTISH LAKES

Source of records: West, G. [T.] (1905). A comparative study of the dominant phanerogamic and higher cryptogamic flora of aquatic habit, in three lake areas of Scotland. *Proceedings of the Royal Society of Edinburgh* 25, 967-1024.

Coverage: selected lakes in the Loch Ness area, Lismore and near Nairn. Vice-counties 96, 97, 98. Grid squares - see Figure 7.

Recorder: G.T. West. Date: c.1904.

Unit of recording: individual lakes (some larger sites subdivided).

Number of sites: 31. Number of records: 432 (excludes records of narrow-leaved *Potamogeton* spp., which were not extracted).

3.34      G.T. WEST      FURTHER SCOTTISH LAKES

Source of records: West, G. [T.] (1910). A further contribution to a comparative study of the dominant phanerogamic and higher cryptogamic flora of aquatic habit in Scottish lakes. *Proceedings of the Royal Society of Edinburgh*, 30, 65-182.

**Coverage:** selected lakes in Kirkcudbrightshire, Wigtownshire, Fife and Kinross. Vice-counties 73-75, 85. Grid squares - see Figure 7.

**Recorder:** G.T. West. **Date:** c.1905.

**Unit of recording:** lakes.

**Number of sites:** 82. **Number of records:** 1 367 (excludes records of narrow-leaved *Potamogeton* spp., which were not extracted).

3.35      M.J. WIGGINTON                      SHROPSHIRE & CHESHIRE MERES

**Source of records:** Wigginton, M. [J.] (1989). Survey of Shropshire and Cheshire Meres 1987. NCC England Field Unit Report no. 59. Unpublished report.

**Coverage:** Shropshire and Cheshire meres. Vice-counties 40, 58. Grid squares: SJ 20, 40, 42, 43, 50, 54, 56, 57, 77, 78.

**Recorder:** NCC England Field Unit. **Date:** 1979, 1987.

**Unit of recording:** individual meres. Aquatic macrophytes listed, with notes on emergent species.

**Number of sites:** 19. **Number of records:** 257

**Note:** more detailed records from the 1979 survey have been processed from the NCC CSD record cards (see 3.19).

3.36      C.P.L. YOUNG & N.F. STEWART                      FIFE & KINROSS LOCHS

**Source of records:** Young, C.P.L. & Stewart, N.F. (1986). A pilot survey of Fife and Kinross lochs to assess changes in the aquatic flora since surveys conducted by G.T. West between 1905 and 1909. Unpublished report.

**Coverage:** lakes and reservoirs in Fife and Kinross previously recorded by G.T. West (cf 3.34). Vice-county 85. Grid squares - see Figure 9.

**Recorder:** C.P.L. Young. **Date:** 1982.

**Unit of recording:** individual lakes and reservoirs.

**Number of sites:** 19. **Number of records:** 540.

Antrim, lakes	3.8
Armagh, lakes	3.8
Basingstoke Canal	3.12
Benbecula, lochs	3.6, 3.27
Berneray, lochs	3.6
Broadland, dykes	3.8, 3.21
Caithness, lochs	3.20
Cheshire, meres	3.35
Chesterfield Canal	3.1
Coll	3.24
Cumbria, lakes	3.29
Deal-Sandwich area, dykes	3.13
Deeside, lochs	3.20
Derwent Ings, ditches	3.21
Donegal	3.25
Down, lakes	3.8
Essex, coastal ditches	3.21
Exminster Marshes	3.21
Fermanagh, lakes	3.8
Fife & Kinross, lakes	3.34, 3.36
Forth & Clyde Canal	3.32
Gigha	3.15
Grand Western Canal	3.3
Grantham Canal	3.5
Great Britain, miscellaneous sites	3.23
standing waters	3.19
Gwent Levels, ditches	3.7

Harris, lochs	3.4
Inverness, lochs	3.20
Ireland, lakes	3.8, 3.14
miscellaneous sites	3.10, 3.23
Jura	3.22
Kirkcudbrightshire, lakes	3.34
Lancaster Canal	3.18
Leven Canal	3.16
Lewis, lochs	3.4
Limestone pavement	3.31
Lismore	3.26, 3.33
Loch Ness area, lakes	3.33
Lochalsh, lochs	3.20
Londonderry, lakes	3.8
Moray, lochs	3.20
Nairn, lakes	3.20, 3.33
N. Norfolk, coastal ditches	3.21
N. Uist, lochs	3.6
Northern Ireland, lakes	3.8
Orkney, lochs	3.20
Peterborough, brickpits	3.17
Pocklington Canal	3.30
Sandwich, see Deal-Sandwich area	
Scotland, lakes/lochs	3.4, 3.6, 3.20, 3.33, 3.34
Shropshire, meres	3.35
Skye, lochs	3.20
S. Argyll, lochs	3.20
S. England, rivers and streams	3.11

S. Uist, lochs	3.6, 3.27
Spey Valley, lochs	3.20
Suffolk, coastal ditches	3.21
Sutherland, lochs	3.20
Tiree	3.24
<hr/>	
Tyrone, lakes	3.8
Union Canal	3.2
Wales, lakes	3.28
Wester Ross, lochs	3.20

The following maps illustrate the coverage of the site-based datasets described in the previous section, all of which have now been computerised or received in machine-readable form. A symbol is plotted in a 10-km square if the relevant dataset contains at least one record from that square. The presence of a symbol in that square does not, therefore, indicate that the square has been comprehensively surveyed for aquatic plants. In a few instances a square will have been thoroughly surveyed, but usually one site or one habitat in the square will have been examined. Figures 6-10 illustrate the coverage of the largest individual datasets; Figure 11 summarises the surveys of individual canals and Figure 12 illustrates the coverage of all the site-based datasets.

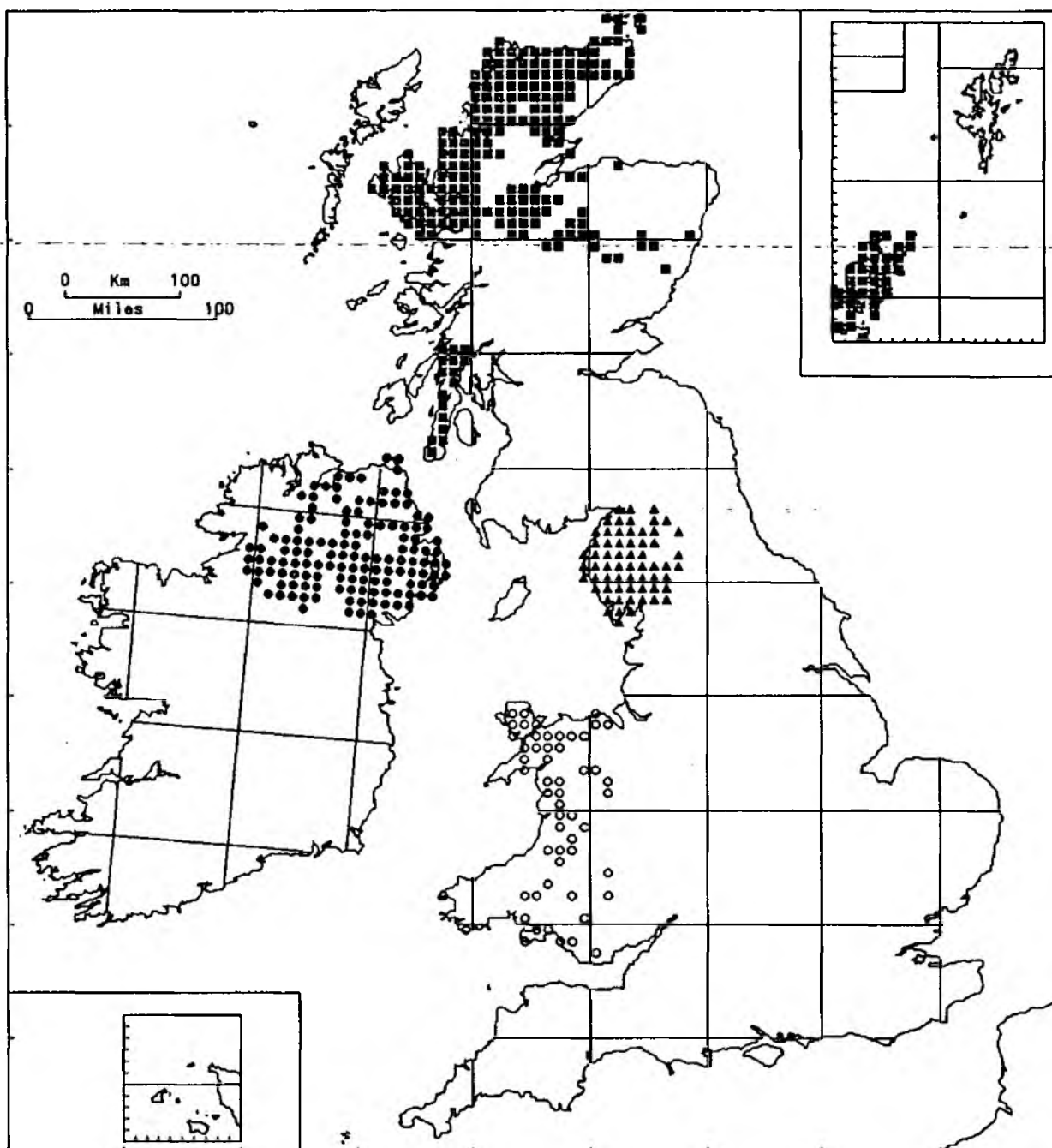


Figure 6 Coverage of four lake surveys.

- Closed circles: DANI/DoE (NI) survey of lakes in Northern Ireland (3.8).  
 Squares: NCC CSD Scottish Loch Survey (3.20).  
 Open circles: Survey of Welsh lakes co-ordinated by B.A. Seddon (3.28).  
 Triangles: R. Stokoe's survey of Cumbrian lakes (3.29).

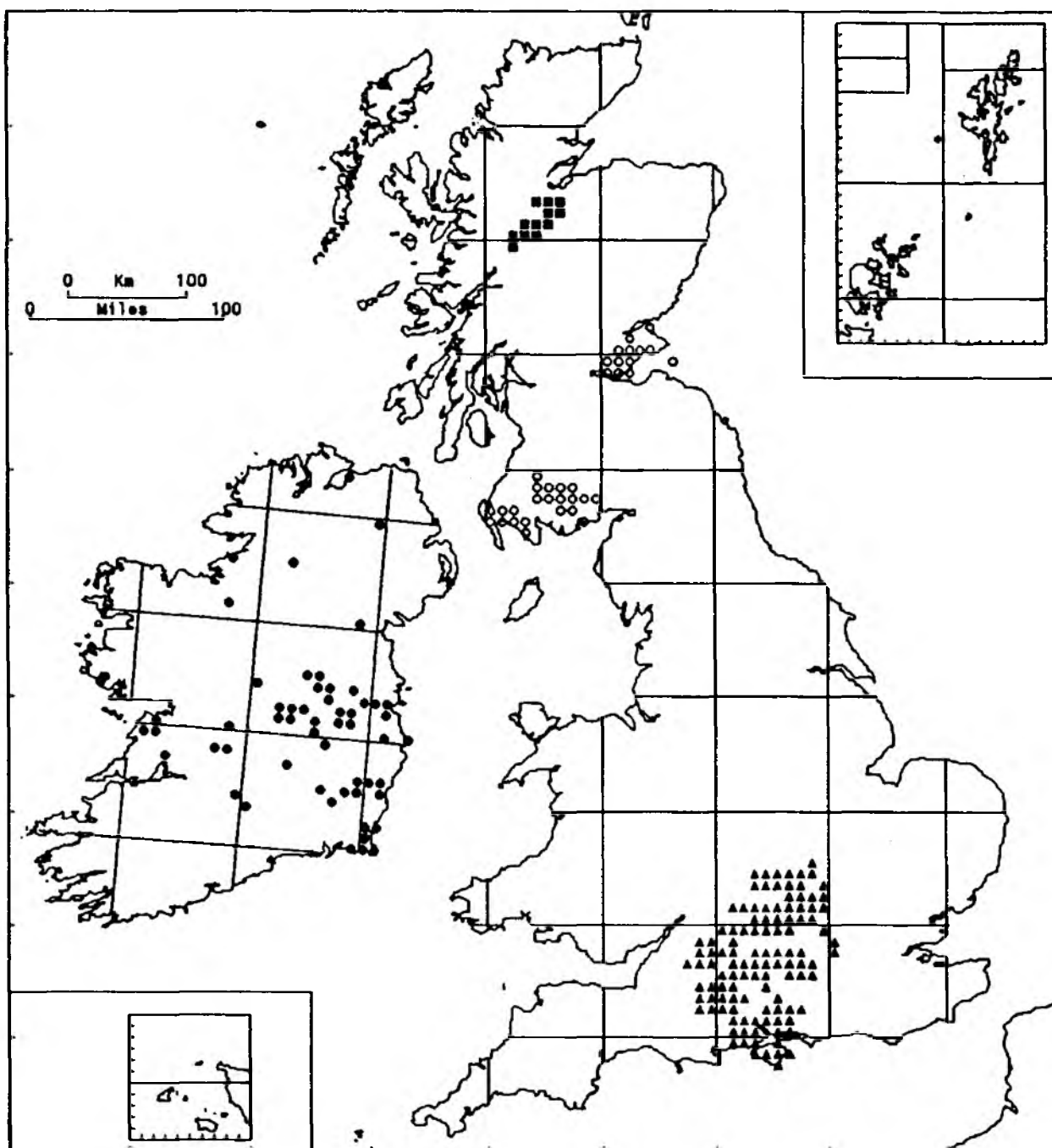


Figure 7 Coverage of four site-based datasets.

Closed circles: Lady R. FitzGerald & N.F.Stewart, Irish sites (3.10).  
 Triangles: P.D. Goriup, rivers and streams (3.11).  
 Open circles: West (1905), Scottish lakes (3.33).  
 Squares: West (1910), further Scottish lakes (3.34).

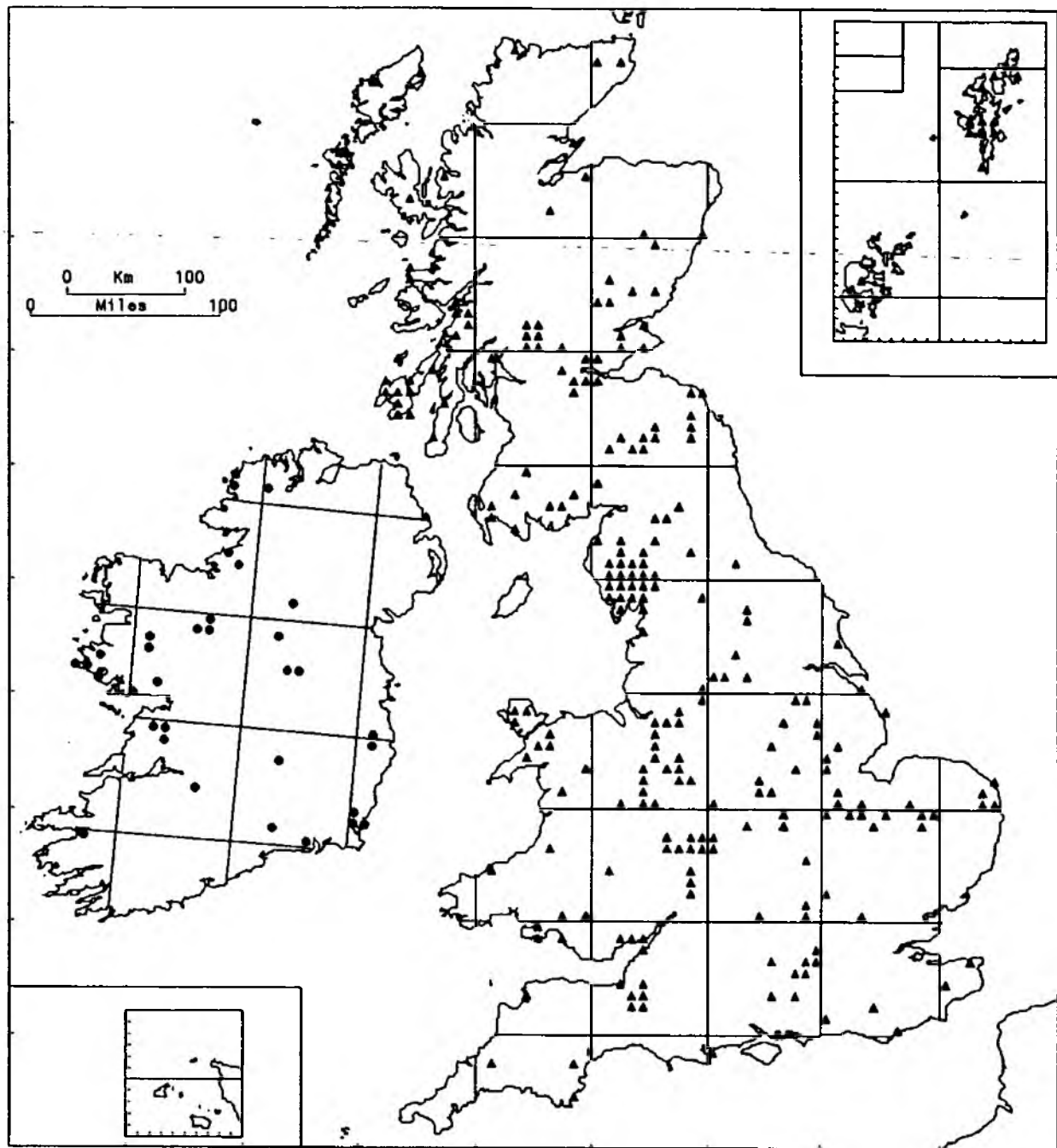


Figure 8 Coverage of two site-based datasets.

Closed circles: H. Heuff, Irish lakes (3.14).  
 Triangles: NCC CSD miscellaneous standing waters (3.19).

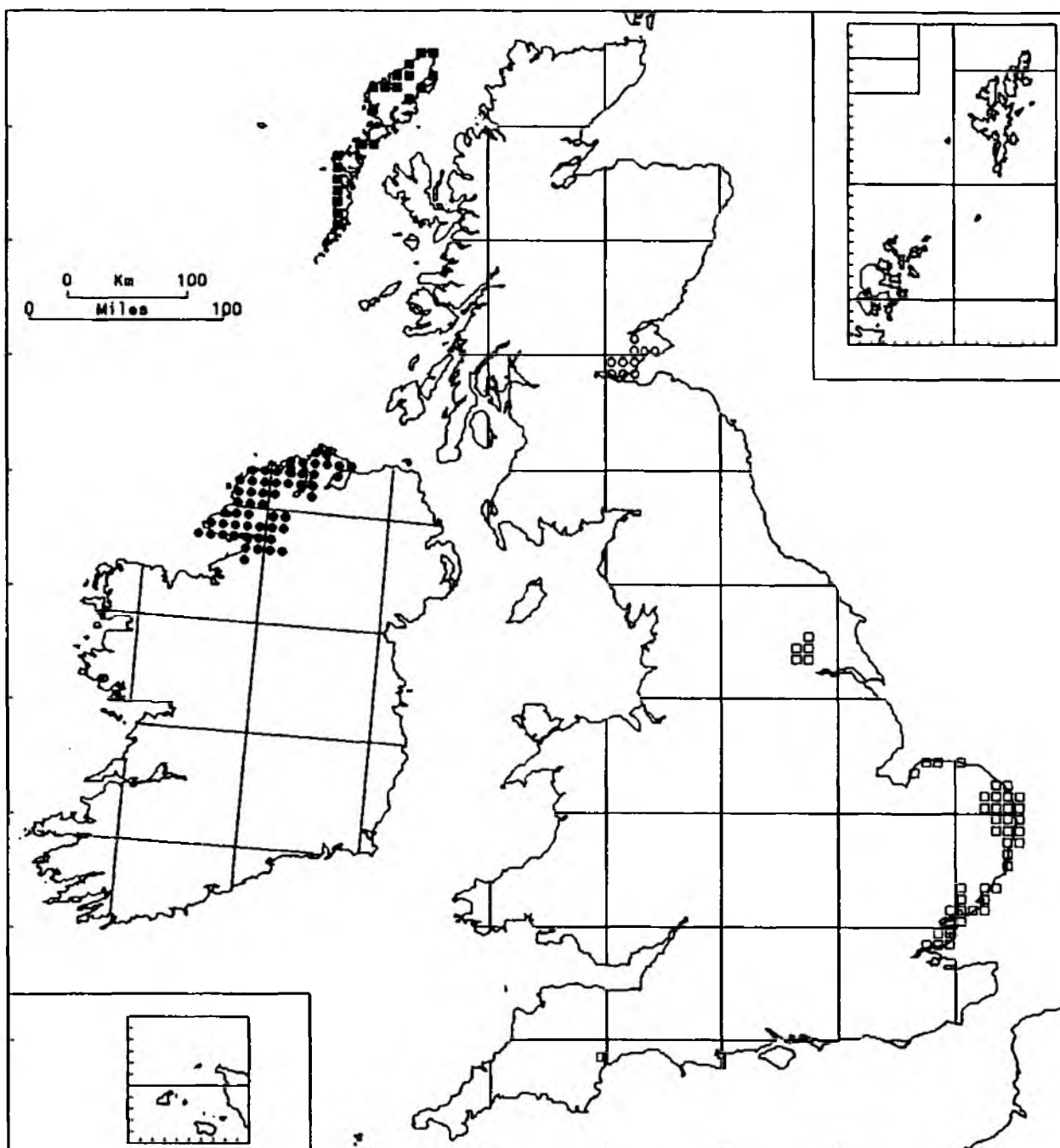


Figure 9 Coverage of six site-based datasets.

- |                 |  |
|-----------------|--|
| Open squares:   | NCC EFU survey of grazing marsh ditches (3.21).  |
| Closed circles: | C.D. Preston & N.F. Stewart, Donegal sites (3.25).                                       |
| Squares:        | Hebridean lakes surveyed by teams from Royal Botanic Garden, Edinburgh (3.4, 3.6, 3.27). |
| Open circles:   | C.P.L. Young & N.F. Stewart, Fife & Kinross lochs (3.36).                                |

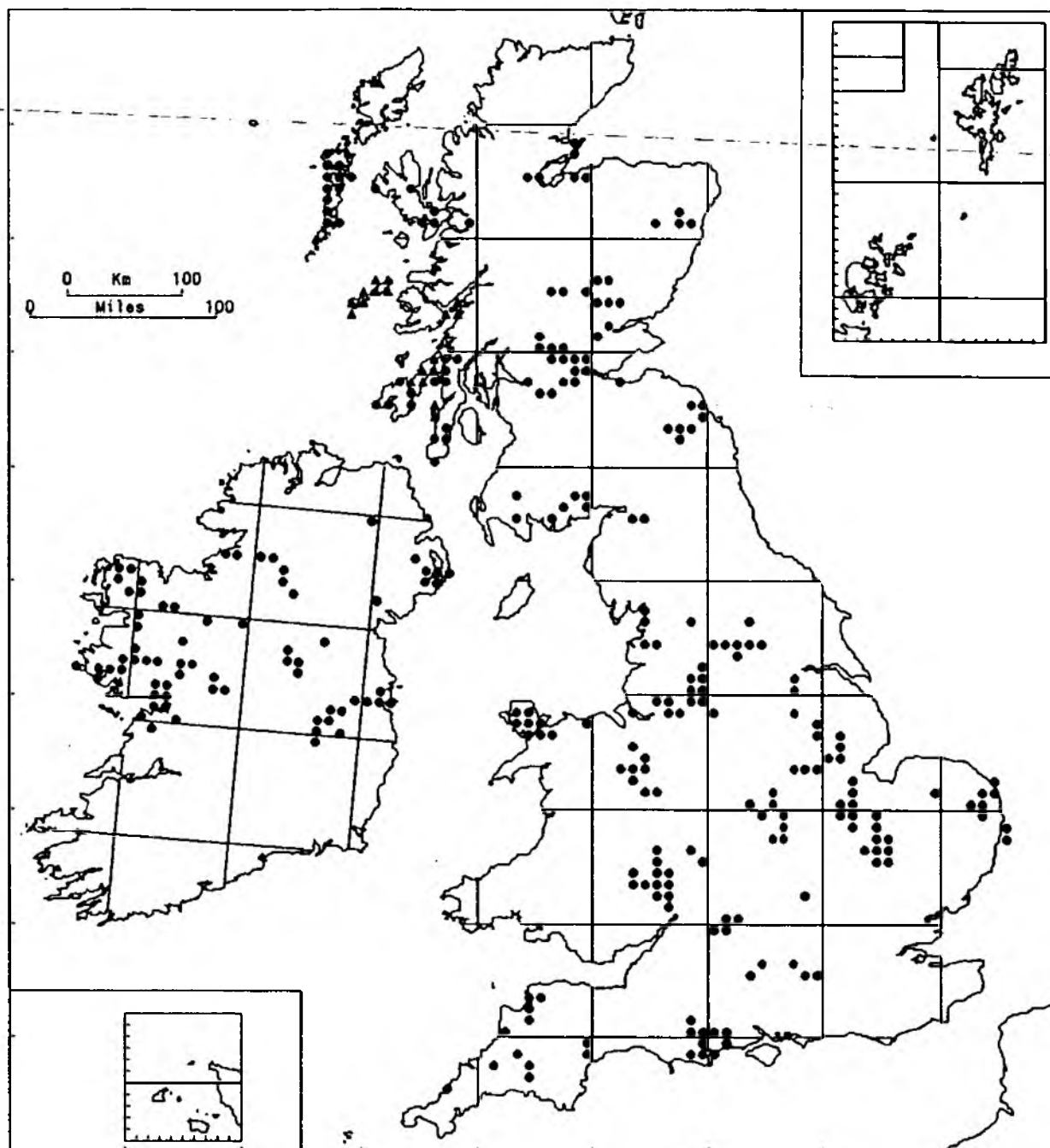
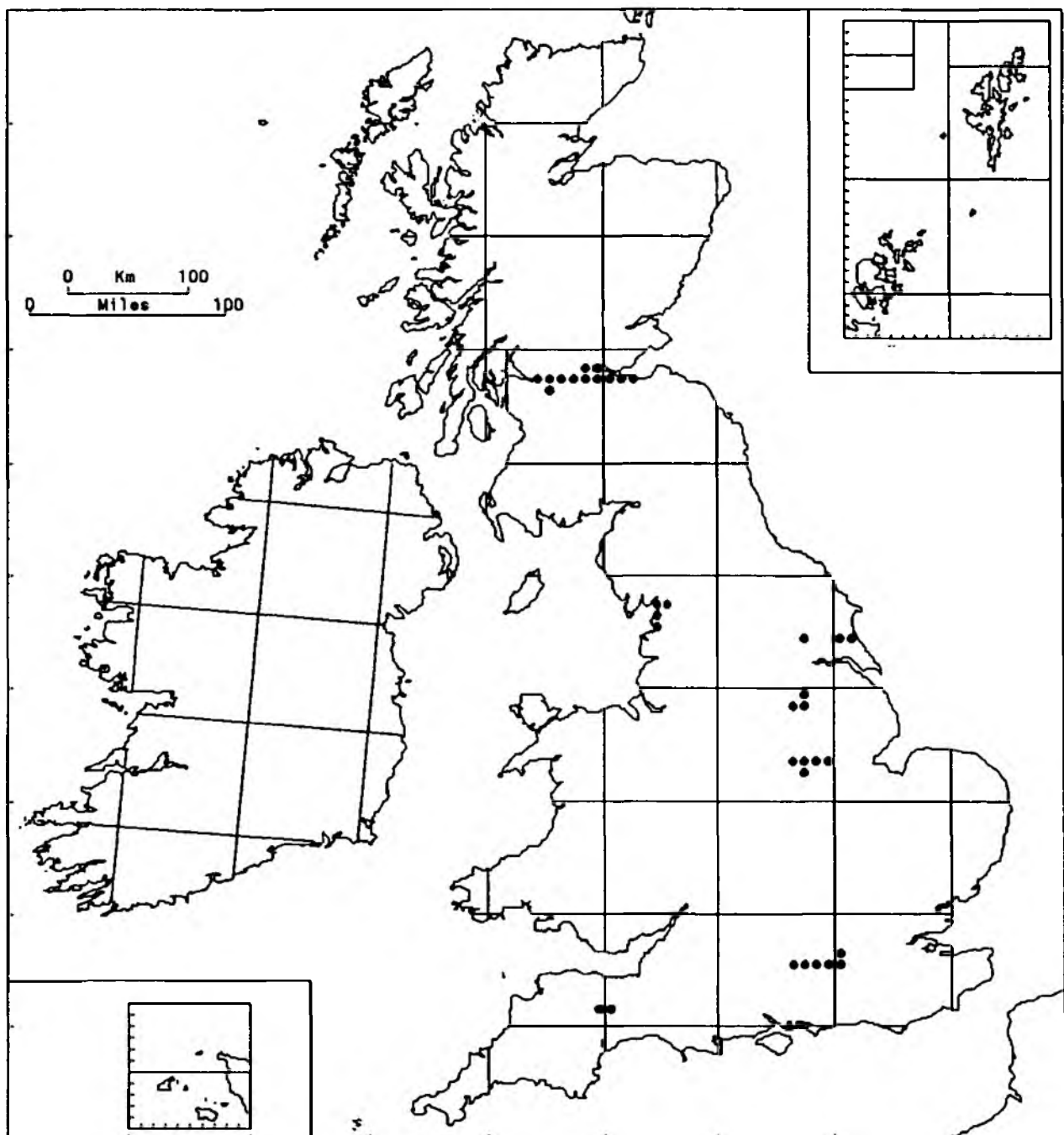
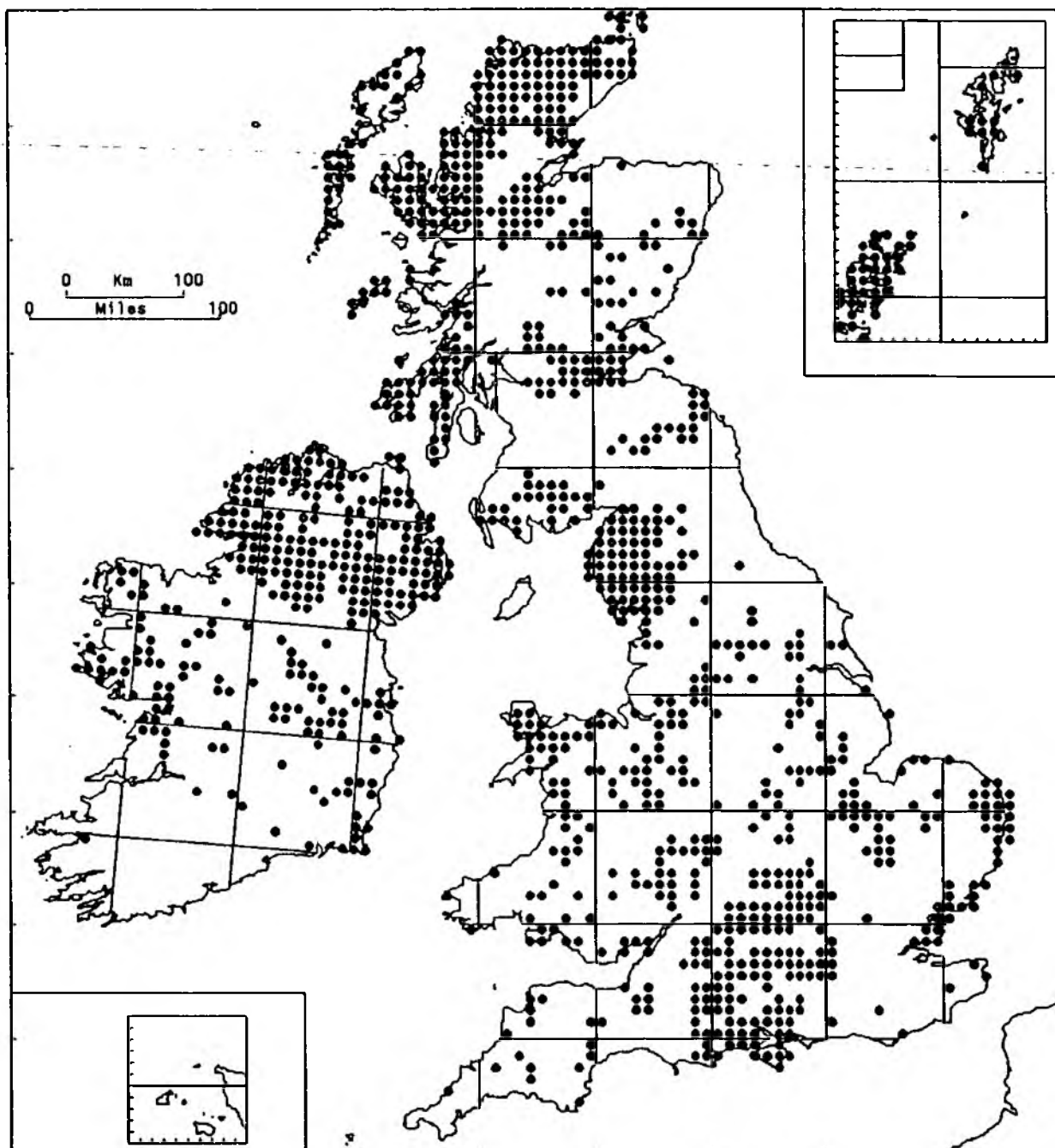


Figure 10 Coverage of five site-based datasets.

Circles: C.D. Preston *et al.*, miscellaneous sites (3.23).  
 Triangles: C.D. Preston & N.F. Stewart, Hebridean islands (3.15, 3.22, 3.24, 3.26).



**Figure 11** Coverage of canal surveys. The map illustrates the coverage of the surveys described in sections 3.1, 3.2, 3.3, 3.5, 3.12, 3.16, 3.18, 3.30 and 3.32. Records from canals in other datasets from miscellaneous sites are not included.



**Figure 12**

Coverage of site-based datasets. The map illustrates the coverage of all the datasets described in section 3 except the limestone pavement survey (3.31), which is excluded as it only incidentally includes records of aquatic species.

Succinct accounts of the aquatic plants covered by the project will be prepared in 1992-3. These accounts will provide text to accompany the distribution maps in the final report and the published Atlas. The following examples are included so that we can obtain comments on their scope and format. The aim is to produce a text for each species of c.250 words, although the length of the text will inevitably vary from species to species.

The vernacular and scientific names at the start of each account follow Stace (1991). Abbreviations indicate the conservation status of each species:

- RB        Included in *British Red Data Books: 1 Vascular Plants* (Perring & Farrell 1983), ie species in 15 or fewer 10-km squares in Great Britain. RB status indicates a species which would now qualify for inclusion, using the same criteria.
- RI        Included in the *The Irish Red Data Book 1 Vascular Plants* (Curtis & McGough 1988), ie species in 10 or fewer 10-km squares in Ireland.
- S        Scarce in Britain, ie in 16-100 10-km squares.
- BC        Species protected by the provisions of the Bern Convention.
- EC        Species included in Annex IIb to the EC Directive for the Conservation of Natural and Semi-natural Habitats and of Wild Flora and Fauna. None of the species covered by the project are included in Annex IVb or Vb.

The habitat of the species is described in the first paragraph. Cross references to the National Vegetation Classification will be made when the relevant volume is published. Brief notes on reproductive biology are given in the second paragraph. These are followed by a paragraph which discusses the past and present distribution in the British Isles: this section will include a mention of species which are misunderstood or under-recorded, a brief history of alien species and a discussion of any changes in the range of native species, or any current threats, and any key references which deal with the management of species. The fourth paragraph summarises the European distribution, with notes on the wider range if this is of particular interest and if reliable information is available. Key references are cited in the text or in a final paragraph: these are intended to provide a lead into the available literature rather than a full bibliography.

#### Common Reed

#### *Phragmites australis* (Cav.) Trin. ex Steudel

A familiar emergent, capable of forming dense, vigorous stands from which most competitors are excluded. These stands occur in low-lying areas which are intermittently flooded, around the permanently flooded edges of still or slowly-flowing waters or at the upper edge of salt marshes. *Phragmites* is most frequent over nutrient-rich substrates, becomes confined to flushed areas where soils are nutrient-poor and is absent from the most oligotrophic habitats. Its competitive ability is reduced in drier sites and it tends to be replaced by *Typha latifolia* or large *Carex* spp. at the upper end of swamps

or as reedbeds become silted up. Stands become thin and shoots less vigorous towards the northern edge of its range. Small colonies grow in a range of terrestrial habitats including moorland, sea cliffs, railway embankments and the edge of arable fields. Predominantly lowland, ascending to 510 m at Brown Clee Hill.

*Phragmites* is a rhizomatous perennial. Shoots grow between April and September; the dead stems are persistent. The flowers are wind-pollinated. Seed set and viability is very variable in Britain. Open habitats are colonised by wind-dispersed seed, but reproduction in closed stands is almost entirely by vegetative spread.

*Phragmites* is frequent and, although locally stands have been reduced (George 1992), the species is not declining. Large stands are important to several bird species (Anderson & Ward 1991) and the dead stems are used for thatching.

Throughout Europe north to 70°N, and with a virtually cosmopolitan world distribution.

The autecological literature on reed is summarised by Haslam (1972); for a classification of reedbed communities see Wheeler (1980). An account of the exploitation of reed for thatching is given by Haslam & McDougall (1972).

#### Water fern                      *Azolla filiculoides* Lam.

A small but highly gregarious floating fern, which can occur in abundance on the surface of canals, ditches, ponds and small lakes or in the sheltered backwaters of larger water bodies. Dense stands exclude almost all competitors; less dense aggregations are often intermixed with *Lemna gibba*, *L. minor* and *L. minuta*. *Ceratophyllum demersum* and *Elodea canadensis* or *E. nuttallii* often grow under the *Azolla* layer. *Azolla* is most frequent in eutrophic, calcareous waters and is often particularly frequent in ditches near the sea. Lowland.

Plants are dispersed by water and, according to Page (1988), perhaps also as fragments on the feet or feathers of birds. They increase very rapidly in the summer by clonal spread; colonies develop a striking red colour in autumn and persist into the early winter but then break up and disappear from view. Regeneration in the spring is thought to be from surviving fragments. However, examination of herbarium specimens shows that sporocarps are regularly produced and British populations may therefore reproduce sexually.

Like *Rhododendron ponticum*, *Azolla* was native to Britain in previous interglacials (West 1953, Godwin 1975) but in this interglacial it only occurs as an introduction. It was first recorded at Pindon in Middlesex in 1883, but did not become well-established until some 25 years later. By 1914 it was well naturalised in the Thames valley and Norfolk Broads, and had been recorded at other scattered localities (Marsh 1914). In Broadland its spread was assisted by floods in 1912. It has continued to spread, and established populations doubtless arose from several different introductions. It can invade a region very rapidly, but although persistent at some sites it only survives for a few years at others or reappears after long intervals. It has been suggested that it is sometimes eliminated from particular sites by hard winters, but the evidence is not conclusive.

A native of N. and S. America, now widely naturalised elsewhere. For a map of its European distribution see Jalas & Suominen (1972).

**Sharp-leaved Pondweed**

*Potamogeton acutifolius* Link

RB status

*P. acutifolius* usually grows in unpolluted calcareous water in shallow ponds and in species-rich drainage ditches in grazing marshes. Characteristic associates include *Elodea canadensis*, *Hottonia palustris*, *Hydrocharis morsus-ranae*, *Lemna minor*, *L. trisulca*, *Myriophyllum verticillatum*, *Potamogeton natans*, *Ranunculus circinatus*, *Sagittaria sagittifolia*, *Spirodela polyrhiza* and *Stratiotes aloides*. In ditches where the water is more eutrophic *Elodea nuttallii*, *Lemna gibba* and *Potamogeton pectinatus* have also been recorded as associates. Although there are two nineteenth century records from canals, it never (unlike the closely related *P. compressus*) became established in the canal system. It is not found as a colonist of newly created habitats such as gravel pits. Lowland.

Turions develop on the stems of *P. acutifolius* from August onwards, and these act as over-wintering organs and as a means of vegetative reproduction. This species produces fruits more frequently than many other linear-leaved pondweeds.

The history of *P. acutifolius* in Britain is one of gradual decline. The species was collected at Beverley in 1798 and near Boston by Sir Joseph Banks at approximately the same time, but it has not subsequently been found as far north as Yorkshire and Lincolnshire. Many sites were lost during the 19th century: it was last recorded at Henfield in 1831, the R. Colne in Hertfordshire in 1846 and from a pool by the R. Thames at Walton Bridge in 1870, for example. This decline continued into the 20th century: not only has *P. acutifolius* disappeared from further sites but at some extant localities (eg the Wareham area) it is now less widespread than it once was. Many of its current localities are grazing marshes protected by SSSI designation. The continued presence of *P. acutifolius* as a British plant would appear to depend not only on the maintenance of the grazing marsh habitat and the sympathetic management of the ditches in which it grows (cf Newbold, Honnor & Buckley 1989) but also on the protection of its sites from the insidious threat of eutrophication.

Widespread in Europe from southern Scandinavia southwards, but absent from the Mediterranean zone. For a map of its world distribution see Hulthen & Fries (1986). *P. acutifolius* is apparently declining in other areas of western Europe, eg Germany (Haeupler & Schönfelder 1988) and the Lorraine region of Belgium and France (Diederich 1983).

We are grateful to the following friends and colleagues for help in obtaining site-based datasets: Miss J. Barneveld & T.H. Blackstock (Countryside Commission for Wales); S.L. Bell, I. Butterfield & E. Clegg (Scottish loch survey); Lady R. FitzGerald; Mrs M. Gibson & S.J.J. Lambert (English Nature); L.A. & P.D. Livermore; L.J. Margetts; Mrs Mary Palmer (ITE); N.F. Stewart; K.J. Watson and S. Wolfe-Murphy (N. Ireland lake survey). We are particularly grateful to N.F. Stewart for extracting his own field records and drawing our attention to one or two reports which we would otherwise have missed. Many of the copies of unpublished reports we have used were gathered together by Mrs Margaret Palmer (JNCC) while working at NCC CSD; she has provided much valuable information about the availability of datasets. We are also grateful to J. Hogger (NRA) for helpful advice during the course of the project. At BRC, much of the data input has been undertaken by Mrs V.J. Burton and Mrs W.A. Forrest, J.C.M. Dring has made a valuable contribution as data manager, particularly in processing data received in machine-readable form, and P.T. Harding has continued to undertake the administration of the contract and provide benevolent guidance and encouragement. We are grateful to Mrs J. Rushton for typing the report.

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APPENDIX A. LIST OF TAXA COVERED BY THE DATABASE AND ATLAS OF AQUATIC VASCULAR PLANTS PROJECT

The plants covered by the project are listed below, with their BRC code numbers. Alien species are denoted by an asterisk. Minor changes to this list agreed by the three funding organisations have been included in the the list below. The main changes are as follows:

- (1) nomenclature now follows Stace (1991); where names used in earlier reports have changed, the previous name is added in italics
- (2) the following species have been added to the list: *Acorus gramineus*, *Calla palustris*, *Callitriche palustris*, *Glyceria declinata*, *Utricularia ochroleuca*, *U. stygia*
- (3) the following species have been deleted from the list: *Zostera angustifolia*, *Z. marina*, *Z. noltii*
- (4) subspecies recognised by Stace (1991) are included for all species on the list
- (5) the list of hybrids has been amended to include all hybrids treated in full by Stace (1991), i.e. well-established hybrids which can sometimes occur in the absence of both parents. With the exception of *Typha x glauca* and *Veronica x lackschewitzii*, hybrids which are not treated in full by Stace have been removed from the list.

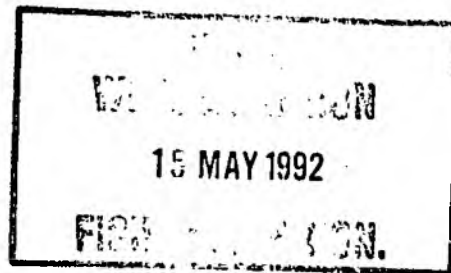
0920	15	* <i>Acorus calamus</i>
0920	4517	* <i>A. gramineus</i>
0920	61	<i>Alisma gramineum</i>
0920	62	<i>A. lanceolatum</i>
0920	63	<i>A. plantago-aquatica</i>
0920	135	<i>Apium inundatum</i>
920	137	<i>A. nodiflorum</i>
0920	139	* <i>Aponogeton distachyos</i>
0910	223	* <i>Azolla filiculoides</i>
0920	224	<i>Baldellia ranunculoides</i>
0920	234	<i>Berula erecta</i>
0920	1860	<i>Bolboschoenus maritimus</i> ( <i>Scirpus maritimus</i> )
0920	288	<i>Butomus umbellatus</i>
0920	301	* <i>Calla palustris</i>
0920	303.2	<i>Callitriche brutia</i>
0920	303.1	<i>C. hamulata</i>
0920	302	<i>C. hermaphroditica</i>
0920	304	<i>C. obtusangula</i>
0920	2289	<i>Callitriche palustris</i>
0920	307.1	<i>C. platycarpa</i>
0920	307.2	<i>C. stagnalis</i>
0920	308	<i>C. truncata</i>
0920	310	<i>Caltha palustris</i>
0920	340	<i>Carex acuta</i>
0920	341	<i>C. acutiformis</i>
0920	342	<i>C. appropinquata</i>
0920	343	<i>C. aquatilis</i>

0920	371	<i>C. elata</i>
0920	386	<i>C. lasiocarpa</i>
0920	388	<i>C. limosa</i>
0920	393	<i>C. nigra</i>
0920	401	<i>C. paniculata</i>
0920	407	<i>C. pseudocyperus</i>
0920	413	<i>C. riparia</i>
0920	414	<i>C. rostrata</i>
0920	424	<i>C. vesicaria</i>
0920	433	<i>Catabrosa aquatica</i>
0920	471	<i>Ceratophyllum demersum</i>
0920	472	<i>C. submersum</i>
0920	523	<i>Cladium mariscus</i>
0920	566	<i>Crassula aquatica</i>
0920	2423	* <i>C. helmsii</i>
0920	615	<i>Damasonium alisma</i>
0920	2551	* <i>Egeria densa</i>
0920	671	<i>Elatine hexandra</i>
0920	672	<i>E. hydropiper</i>
0920	673	<i>Eleocharis acicularis</i>
0920	674	<i>E. multicaulis</i>
0920	675.1	<i>E. palustris</i> subsp. <i>palustris</i>
0920	675.2	<i>E. palustris</i> subsp. <i>vulgaris</i>
0920	679	<i>Eleogiton fluitans</i>
0920	680	* <i>Elodea callitrichoides</i> ( <i>E. ernstiae</i> )
0920	681	* <i>E. canadensis</i>
0920	997	* <i>E. nuttallii</i>
0910	713	<i>Equisetum fluviatile</i>
0910	717	<i>E. palustre</i>
0920	715	<i>E. x litorale</i> ( <i>arvense</i> x <i>fluviatile</i> )
0920	739	<i>Eriocaulon aquaticum</i> ( <i>E. septangulare</i> )
0920	932	<i>Glyceria declinata</i>
0920	933	<i>G. fluitans</i>
0920	934	<i>G. maxima</i>
0920	936	<i>G. notata</i> ( <i>G. plicata</i> )
0920	935	<i>G. x pedicellata</i> ( <i>fluitans</i> x <i>notata</i> )
0920	944	<i>Groenlandia densa</i>
0920	981	<i>Hippuris vulgaris</i>
0920	995	<i>Hottonia palustris</i>
0920	2291	<i>Hydrilla verticillata</i>
0920	998	<i>Hydrocharis morsus-ranae</i>
0920	999	<i>Hydrocotyle vulgaris</i>
0920	1038	<i>Iris pseudacorus</i>
0920	1040	* <i>I. versicolor</i>
0920	2845	* <i>I. x robusta</i> ( <i>versicolor</i> x <i>virginica</i> )
0910	1043	<i>Isoetes echinospora</i>
0910	1045	<i>I. lacustris</i>
0920	1050	<i>Juncus acutiflorus</i>
0920	1054	<i>J. articulatus</i>
0920	1058	<i>J. bulbosus</i>
0920	1096	* <i>Lagarosiphon major</i>
0920	1125	<i>Lemna gibba</i>
0920	1126	<i>L. minor</i>
0920	2300	* <i>L. minuta</i> ( <i>L. minuscula</i> )
0920	1128	<i>L. trisulca</i>

0920	1175	<i>Littorella uniflora</i>
0920	1177	<i>Lobelia dortmanna</i>
0920	1042	<i>Ludwigia palustris</i>
0920	1198	<i>Luronium natans</i>
0920	1444	<i>Lythrum portula</i>
0920	1227	<i>L. salicaria</i>
0920	1272	<i>Mentha aquatica</i>
0920	1289	<i>Menyanthes trifoliata</i>
0920	1322	<i>Myosotis scorpioides</i>
0920	1330	<i>Myriophyllum alterniflorum</i>
0920	4433	* <i>M. aquaticum</i>
0920	4496	* <i>M. heterophyllum</i>
0920	1331	<i>M. spicatum</i>
0920	4495	* <i>M. verrucosum</i>
0920	1332	<i>M. verticillatum</i>
0920	1334	<i>Najas flexilis</i>
0920	1335	* <i>N. graminea</i>
0920	1336	<i>N. marina</i>
0920	4501	* <i>Nuphar advena</i>
0920	1356	<i>N. lutea</i>
0920	1357	<i>N. pumila</i>
0920	1355	<i>N. x spenneriana</i> ( <i>lutea</i> x <i>pumila</i> )
0920	1358.1	<i>Nymphaea alba</i> subsp. <i>alba</i>
0920	1358.2	<i>Nymphaea alba</i> subsp. <i>occidentalis</i>
0920	1360	<i>Nymphoides peltata</i>
0920	1362	<i>Oenanthe aquatica</i>
0920	1363	<i>O. crocata</i>
0920	1364	<i>O. fistulosa</i>
0920	1365	<i>O. fluviatilis</i>
0920	1521	<i>Persicaria amphibia</i> ( <i>Polygonum amphibium</i> )
0920	1454	<i>Phalaris arundinacea</i>
0920	1465	<i>Phragmites australis</i>
0910	1474	<i>Pilularia globulifera</i>
0920	1557	<i>Potamogeton acutifolius</i>
0920	1558	<i>P. alpinus</i>
0920	1559	<i>P. berchtoldii</i>
0920	1561	<i>P. coloratus</i>
0920	1562	<i>P. compressus</i>
0920	1563	<i>P. crispus</i>
0920	1565	<i>P. epihydrus</i>
0920	1566	<i>P. filiformis</i>
0920	1567	<i>P. friesii</i>
0920	1568	<i>P. gramineus</i>
0920	1569	<i>P. lucens</i>
0920	1570	<i>P. natans</i>
0920	1572	<i>P. nodosus</i>
0920	1573	<i>P. obtusifolius</i>
0920	574	<i>P. pectinatus</i>
0920	1575	<i>P. perfoliatus</i>
0920	1576	<i>P. polygonifolius</i>
0920	1577	<i>P. praelongus</i>
0920	1578	<i>P. pusillus</i>
0920	1579	<i>P. rutilus</i>
0920	1581	<i>P. trichoides</i>
0920	2481	<i>P. x cooperi</i> ( <i>crispus</i> x <i>perfoliatus</i> )
0920	2488	<i>P. x lintonii</i> ( <i>crispus</i> x <i>friesii</i> )

0920	1571	<i>P. x nitens</i> (gramineus x perfoliatus)
0920	2491	<i>P. x olivaceus</i> (alpinus x crispus)
0920	1564	<i>P. x salicifolius</i> (lucens x perfoliatus)
0920	2494	<i>P. x sparganifolius</i> (gramineus x natans)
0920	1580	<i>P. x suecicus</i> (filiformis x pectinatus)
0920	1582	<i>P. x zizii</i> (gramineus x lucens)
0920	1592	<i>Potentilla palustris</i>
0920	1643.1	<i>Ranunculus aquatilis</i>
0920	1646	<i>R. baudotii</i>
0920	1648	<i>R. circinatus</i>
0920	1651.1	<i>R. flammula</i> subsp. <i>flammula</i>
0920	1651.3	<i>R. flammula</i> subsp. <i>minimus</i>
0920	1651.2	<i>R. flammula</i> subsp. <i>scoticus</i>
0920	1652	<i>R. fluitans</i>
0920	1653	<i>R. hederaceus</i>
0920	1655	<i>R. lingua</i>
0920	1654	<i>R. omiophyllus</i>
0920	1643.2	<i>R. peltatus</i>
0920	1634.8	<i>R. penicillatus</i> subsp. <i>penicillatus</i>
0920	1643.6	<i>R. penicillatus</i> subsp. <i>pseudofluitans</i> var. <i>pseudofluitans</i>
0920	1643.7	<i>R. penicillatus</i> subsp. <i>pseudofluitans</i> var. <i>vertumnus</i>
0920	1663	<i>R. sceleratus</i>
0920	1664	<i>R. trichophyllus</i>
0920	1665	<i>R. tripartitus</i>
0920	2671	<i>R. x bachii</i> (fluitans x aquatilis and fluitans x trichophyllus)
0920	2672	<i>R. x kelchoensis</i> (fluitans x peltatus)
0920	2665	<i>R. x novae-forestae</i> (omiophyllus x tripartitus)
0920	1701	<i>Rorippa amphibia</i>
0920	1346	<i>R. microphylla</i> ( <i>Nasturtium microphyllum</i> )
0920	1347	<i>R. nasturtium-aquaticum</i> ( <i>Nasturtium officinale</i> )
0920	2653	<i>R. x anceps</i> (amphibia x sylvestris)
0920	2654	<i>R. x erythrocaulis</i> (amphibia x palustris)
0920	1349	<i>R. x sterilis</i> (microphylla x nasturtium-aquaticum)
0920	1739	<i>Rumex aquaticus</i>
0920	1745	<i>R. hydrolapathum</i>
0920	1759	<i>Ruppia cirrhosa</i>
0920	1758	<i>R. maritima</i>
0920	4500	* <i>Sagittaria latifolia</i>
0920	1770	* <i>S. rigida</i>
0920	1771	<i>S. sagittifolia</i>
0920	4499	* <i>S. subulata</i>
0920	1851	<i>Schoenoplectus lacustris</i>
0920	1849	<i>S. pungens</i>
0920	1852	<i>S. tabernaemontani</i>
0920	1853	<i>S. triqueter</i>
0920	1980	<i>Sparganium angustifolium</i>
0920	1983	<i>S. emersum</i>
0920	1981.1	<i>S. erectum</i> subsp. <i>erectum</i>
0920	1981.3	<i>S. erectum</i> subsp. <i>microcarpum</i>
0920	1981.2	<i>S. erectum</i> subsp. <i>neglectum</i>
0920	1981.4	<i>S. erectum</i> subsp. <i>oocarpum</i>
0920	1982	<i>S. natans</i> ( <i>S. minimum</i> )
0920	1127	<i>Spirodela polyrhiza</i> ( <i>Lemna polyrhiza</i> )
0920	2017	<i>Stratiotes aloides</i>

0920	2020	<i>Subularia aquatica</i>
0920	2110	<i>Typha angustifolia</i>
0920	2111	<i>T. latifolia</i>
0920	2880	<i>T. x glauca</i> ( <i>angustifolia</i> x <i>latifolia</i> )
0920	2131	<i>Utricularia australis</i>
0920	4333	<i>U. intermedia</i>
0920	2130	<i>U. minor</i>
0920	4334	<i>U. ochroleuca</i>
0920	4335	<i>U. stygia</i>
0920	2133	<i>U. vulgaris</i>
0920	2147	* <i>Vallisneria spiralis</i>
0920	2163	<i>Veronica anagallis-aquatica</i>
0920	2166	<i>V. beccabunga</i>
0920	2167	<i>V. catenata</i>
0920	2164	<i>V. x lackschewitzii</i> ( <i>anagallis-aquatica</i> x <i>catenata</i> )
0920	2231	<i>Wolffia arrhiza</i>
0920	2237	<i>Zannichellia palustris</i>



National Rivers Authority  
Northumbria Region

## M E M O R A N D U M

**To:** Fisheries, Recreation, Conservation and Navigation  
Function Managers.  
**From:** Dr Neil Smith, R & D Co-ordinator.  
**Date:** 24 April 1992

Our Ref: NS/AJG

### R & D PROJECT FO1(91)10 - DATABASE AND ATLAS OF AQUATIC VASCULAR PLANTS, PHASE II

Please find enclosed a copy of the Interim Report (<sup>352</sup>~~235~~/1/N) for this R & D project. As stated in the Dissemination Status Note, could you ensure that all relevant biology and conservation staff in your Region are able to see this document.

If you have any comments on this report please contact either myself or the Project Leader, Dr John Hogger.

Yours sincerely

Dr Neil Smith  
R & D Co-ordinator  
(MNS24A92)

Enc.

Anglian	Dr R Linfield
North West	Mr C Newton
Severn Trent	Dr J Wooland
Southern	Dr B Buckley
Yorkshire	Dr J Shillcock

South West	Mr S Bray
Thames	Mr A Birtles
Welsh	Mr W Ayton
Wessex	Mr A Barber

Return to AJ.

cc: Paul Raven  
Topic Leader